

Appln No. 10/635,122
Amdt date August 16, 2006
Reply to Office action of June 16, 2006

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Original) A polymer electrolyte for a lithium sulfur battery comprising:
a monomer including a methacrylate group;
an initiator; and
an electrolytic solution comprising an organic solvent and a lithium salt.
2. (Original) The polymer electrolyte of claim 1, wherein the monomer has at least one carbon-carbon double bond at a terminal end.
3. (Currently Amended) The polymer electrolyte of claim 2, wherein the monomer is selected from the group consisting of multifunctional acrylates, poly(ethyleneglycol) dimethacrylate, poly(ethyleneglycol) diacrylate, poly(ethyleneglycol) divinylether ethylene glycol dimethacrylate, ethylene glycol diacrylate, ethyleneglycol divinylether, hexanediol diacrylate, tripropyleneglycol diacrylate, tetraethyleneglycol monoacrylate, caprolactone acrylate and mixtures thereof, wherein the multifunctional acrylate is poly(ester)(metha)acrylate poly(ester)(meth)acrylate in which hydroxide groups in (polyester)polyol are partially or totally substituted with (metha)acrylic (meth)acrylic ester and un-substituted hydroxide groups are substituted with a group having no radical reactivity.
4. (Currently Amended) The polymer electrolyte of claim 3, wherein the monomer is polyethyleneglycoldimethacrylate or poly(ester)(metha)acrylate poly(ester)(meth)acrylate in which hydroxide groups in (polyester)polyol are partially or totally substituted with (metha)acrylic (meth)acrylic ester and un-substituted hydroxide groups are substituted with a group having no radical reactivity.

Appln No. 10/635,122

Amdt date August 16, 2006

Reply to Office action of June 16, 2006

5. (Original) The polymer electrolyte of claim 3, wherein the group having no radical reactivity is selected from the group consisting of C₁ to C₂₀ aliphatic hydrocarbon groups, C₅ to C₂₀ aromatic hydrocarbon groups, C₁ to C₂₀ ether groups, and C₁ to C₂₀ ester groups.

6. (Original) The polymer electrolyte of claim 3, wherein the mixing mole ratio of the methacrylic ester and the group having no radical reactivity is 1 : 0.01 to 1 : 100.

7. (Currently Amended) The polymer electrolyte of claim 3, wherein the monomer is poly(ester)(metha)acrylate poly(ester)(meth)acrylate in which hydroxide groups in (polyester)polyol are partially or totally substituted with (metha)acrylic (meth)acrylic ester and un-substituted hydroxide groups are substituted with a group having no radical reactivity.

8. (Original) The polymer electrolyte of claim 1, wherein the mixing weight ratio of the electrolytic solution to the monomer ranges from greater than 10:1 to 200:1.

9. (Original) The polymer electrolyte of claim 8, wherein the mixing weight ratio of the electrolytic solution to the monomer is 40 to 150 : 1.

10. (Original) The polymer electrolyte of claim 9, wherein the mixing weight ratio of the electrolytic solution to the monomer is 60 to 120 : 1.

11. (Currently Amended) The polymer electrolyte of claim [[3]] 5, wherein the group having no radical reactivity is selected from the group consisting of -OC(=O)(CH₂)₃CH₃, -OC(=O)Ar where Ar is an unsubstituted or substituted aromatic hydrocarbon group, -OC(=O)(CH₂)_nO(CH₂)_nCH₃ where n is an integer from 1 to 20, -O(C=O)(CH₂)_nOC(=O)(CH₂)_nCH₃ where n is an integer from 1 to 20, and -O(C=O)CH=CH₂.

12. (Currently Amended) The polymer electrolyte of claim [[1]] 3, wherein the monomer is a (metha)acrylic (meth)acrylic ester selected from -OC(=O)(CH₂)_nOC(=O)CH=CH₂

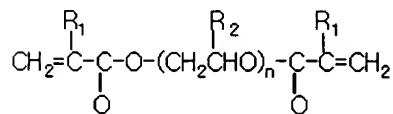
Appln No. 10/635,122
Amdt date August 16, 2006
Reply to Office action of June 16, 2006

and

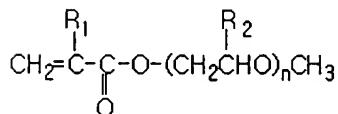
-OC(=O)(CH₂)_nOC(=O)C(CH₃)=CH₂, wherein n is an integer of 1 to 20.

13. (Original) The polymer electrolyte of claim 1, wherein the monomer is selected from compounds represented by the formulas 1 and 2:

Formula 1



Formula 2



where R₁ is H or a C₁ to C₆ alkyl group; n is an integer from 1 to 100,000; and R₂ is H or a C₁ to C₆ alkyl group.

14. (Original) The polymer electrolyte of claim 1, wherein the initiator is at least one selected from the group consisting of isobutyl peroxide, lauroyl peroxide, benzoyl peroxide, m-tolluoyl peroxide, t-butyl peroxy-2-ethyl hexanoate, t-butyl peroxy bibarate, t-butyloxyneodecanate, diisopropyl peroxy dicarbonate, diethoxy peroxy dicarbonate, bis-(4-t-butylcyclohexyl)peroxy dicarbonate, dimethoxy isopropyl peroxy dicarbonate, dicyclo hexylperoxy dicarbonate, 3,3,5-trimethylhexanoyl peroxide, succinic peroxide didecarbonylperoxide, dicumyl peroxide, di-t-butyl peroxide, 2,5-dimethyl-2,5-di(t-butylperoxy)hexane, alpha-cumyl peroxy neodecanate, 1,1-dimethyl-3-hydroxybutyl peroxy-2-ethyl hexanoate, 2,5-dihydroperoxy-2,5-dimethylhexane, cumene hydroperoxide, t-butyl hydroperoxide, 2,2-di(t-butylperoxy)butane, ethyl 3,3-di(t-butylperoxy)-butylate, di(n-propyl)peroxy-dicarbonate, di(sec-butyl)peroxy dicarbonate, di(2-ethylhexyl)peroxy dicarbonate, and azobis isobutyronitrile.

Appln No. 10/635,122
Amdt date August 16, 2006
Reply to Office action of June 16, 2006

15. (Original) The polymer electrolyte of claim 1, wherein the initiator is present in an amount of 0.3 to 5 parts by weight based on 100 parts by weight of the polymer.

16. (Currently Amended) The polymer electrolyte of claim [[1]] 3, wherein the polyester polyol is at least one selected from the group consisting of trialkylols, glycerols, and erythritols.

17. (Original) A lithium sulfur battery comprising:

a positive electrode comprising at least one positive active material selected from the group consisting of elemental sulfur, sulfur-based compounds, and mixtures thereof;

a negative electrode comprising a negative active material selected from the group consisting of materials that are capable of reversibly intercalating or deintercalating lithium ions, materials that react with lithium ions to prepare a lithium-included compound, lithium metals, and lithium alloys; and

a polymer electrolyte comprising a monomer including a methacrylate group, an initiator, and an electrolytic solution comprising an organic solvent and a lithium salt.

18. (Original) The polymer electrolyte of claim 17, wherein the monomer has at least one carbon-carbon double bond at a terminal end.

19. (Currently Amended) The lithium sulfur battery of claim 18, wherein the monomer is selected from the group consisting of multifunctional acrylates, poly(ethyleneglycol) dimethacrylate, poly(ethyleneglycol) diacrylate, poly(ethyleneglycol) divinylether ethylene glycol dimethacrylate, ethylene glycol diacrylate, ethyleneglycol divinylether, hexanediol diacrylate, tripropyleneglycol diacrylate, tetraethyleneglycol monoacrylate, caprolactone acrylate and mixtures thereof, wherein the multifunctional acrylate is poly(ester)(metha)acrylate poly(ester)(meth)acrylate in which hydroxide groups in (polyester)polyol are partially or totally substituted with (metha)acrylic (meth)acrylic ester and un-substituted hydroxide groups are substituted with a group having no radical reactivity.

Appln No. 10/635,122
Amdt date August 16, 2006
Reply to Office action of June 16, 2006

20. (Currently Amended) The lithium sulfur battery of claim 19, wherein the monomer is polyethyleneglycoldimethacrylate or poly(ester)(metha)acrylate poly(ester)(meth)acrylate in which hydroxide groups in (polyester)polyol are partially or totally substituted with (metha)acrylic (meth)acrylic ester, and un-substituted hydroxide groups are substituted with a group having no radical reactivity.

21. (Currently Amended) The lithium sulfur battery of claim 20, wherein the monomer is poly(ester)(metha)acrylate poly(ester)(meth)acrylate in which hydroxide groups in (polyester)polyol are partially or totally substituted with (metha)acrylic (meth)acrylic ester, and un-substituted hydroxide groups are substituted with a group having no radical reactivity.

22. (Original) The lithium sulfur battery of claim 19, wherein the group having no radical reactivity is selected from the group consisting of C₁ to C₂₀ aliphatic hydrocarbon groups, C₅ to C₂₀ aromatic hydrocarbon groups, C₁ to C₂₀ ether groups and C₁ to C₂₀ ester groups.

23. (Original) The lithium sulfur battery of claim 19, wherein the group having no radical reactivity is selected from the group consisting of -OC(=O)(CH₂)₃CH₃, -OC(=O)Ar where Ar is an unsubstituted or substituted aromatic hydrocarbon group, -OC(=O)(CH₂)_nO(CH₂)_nCH₃ where n is an integer of 1 to 20, -O(C=O)(CH₂)_nOC(=O)(CH₂)_nCH₃ where n is an integer of 1 to 20, and -O(C=O)CH=CH₂.

24. (Original) The lithium sulfur battery of claim 17, wherein the mixing weight ratio of the electrolytic solution to the monomer ranges from greater than 10:1 to 200:1.

25. (Original) The lithium sulfur battery of claim 24, wherein the mixing weight ratio of the electrolytic solution to the monomer is 40 to 150 : 1.

26. (Original) The lithium sulfur battery of claim 25, wherein the mixing weight ratio of the electrolytic solution to the monomer is 60 to 120 : 1.

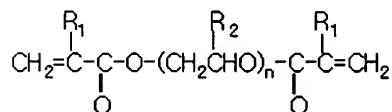
Appln No. 10/635,122
Amdt date August 16, 2006
Reply to Office action of June 16, 2006

27. (Currently Amended) The lithium sulfur battery of claim 17, wherein the monomer is a (metha)acrylic (meth)acrylic ester selected from -OC(=O)(CH₂)_nOC(=O)CH=CH₂ and -OC(=O)(CH₂)_nOC(=O)C(CH₃)=CH₂, where n is an integer of 1 to 20.

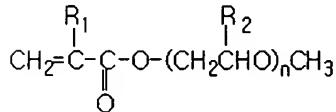
28. (Currently Amended) The lithium sulfur battery of claim 17, wherein the monomer is selected from the group consisting of polymers of polyester (metha)acrylate (meth)acrylate in which hydroxide groups in polyester polyol are partially or totally substituted with (metha)acrylic (meth)acrylic ester, poly(ethyleneglycol)dimethacrylate, poly(ethyleneglycol) diacrylate, poly(ethyleneglycol) divinylether ethylene glycol dimethacrylate, ethylene glycol diacrylate, ethyleneglycol divinylether, hexanediol diacrylate, tripropyleneglycol diacrylate, tetraethyleneglycol monoacrylate, caprolactone acrylate, and mixtures thereof.

29. (Original) The lithium sulfur battery of claim 17, wherein the monomer is selected from compounds represented by the formulas 1 and 2:

Formula 1



Formula 2



where R₁ is H or a C₁ to C₆ alkyl group; n is an integer of 1 to 100,000; and R₂ is H or a C₁ to C₆ alkyl group.

30. (Original) The lithium sulfur battery of claim 19, wherein the mixing mole ratio of the methacrylic ester and the group having no radical reactivity is 1 : 0.01 to 1 : 100.

Appln No. 10/635,122

Amdt date August 16, 2006

Reply to Office action of June 16, 2006

31. (Original) The lithium sulfur battery of claim 17, wherein the initiator is at least one selected from the group consisting of isobutyl peroxide, lauroyl peroxide, benzoyl peroxide, m-toluoyl peroxide, t-butyl peroxy-2-ethyl hexanoate, t-butyl peroxy bibarate, t-butyloxynodecanate, diisopropyl peroxy dicarbonate, diethoxy peroxy dicarbonate, bis-(4-t-butylcyclohexyl)peroxy dicarbonate, dimethoxy isopropyl peroxy dicarbonate, dicyclo hexylperoxy dicarbonate, 3,3,5-trimethylhexanoyl peroxide, succinic peroxide didecarbonylperoxide, dicumyl peroxide, di-t-butyl peroxide, 2,5-dimethyl-2,5-di(t-butylperoxy)hexane, alpha-cumyl peroxy neodecanate, 1,1-dimethyl-3-hydroxybutyl peroxy-2-ethyl hexanoate, 2,5-dihydroperoxy-2,5-dimethylhexane, cumene hydroperoxide, t-butyl hydroperoxide, 2,2-di(t-butylperoxy)butane, ethyl 3,3-di(t-butylperoxy)-butylate, di(n-propyl)peroxy-dicarbonate, di(sec-butyl)peroxy dicarbonate, di(2-ethylhexyl)peroxy dicarbonate, and azobis isobutyronitrile.

32. (Original) The lithium sulfur battery of claim 17, wherein the initiator is present in an amount of 0.3 to 5 parts by weight based on 100 parts by weight of the polymer.

33. (Original) The lithium sulfur battery of claim 17, wherein the polyester polyol is at least one selected from the group consisting of trialkylols, glycerols, and erythritols.

34. (Original) The lithium sulfur battery of claim 17, wherein the positive active material is selected from the group consisting of elemental sulfur, organic sulfur compounds selected from the group consisting of Li_2S_n , where $n \geq 1$, and Li_2S_n , where $n \geq 1$, dissolved in catholyte, and a carbon-sulfur polymer of the formula $(\text{C}_2\text{S}_x)_n$, where $x=2.5$ to 50 and $n \geq 2$.